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RESEARCH

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Sensibilidade de germes relacionados à pneumonia associada à ventilação mecânica

Sensibilidad de gérmenes relacionados con la neumonía asociada a la ventilación mecánica

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ABSTRACT

Objective: To analyze the prevalence of germs related pneumonia associated with mechanical ventilation and their sensitivities profiles. **Methods**: descriptive epidemiological study, with a quantitative approach. The sample consisted of 99 patients using mechanical ventilation in two intensive care units in a public and teaching hospital in the municipality of Teresina-Piauí. The data were collected by means of a form in the months of January and February 2009, statistically processed and presented in the form of tables. **Results**: The most prevalent pathogens were: *Klebsiella spp* (40.40%); Bacillus Gram-Negativo non-fermentor (24.24%); *Staphylococcus aureus* and *pseudomonas aeruginosa* (17.17%). There was a higher bacterial susceptibility to imipenem (76.77%), meropenem (72.73%) and cefepime (58.59%). **Conclusion**: Appropriate therapy and prevention strategies reduce the prevalence rates of pneumonia associated with mechanical ventilation and the emergence of microbial resistance. **Descriptors:** Nosocomial infection, Pneumonia, Prevalence, Microbial Sensitivity tests.

RESUMO

Objetivo: Analisar a prevalência dos germes relacionados às pneumonias associadas à ventilação mecânica e seus perfis de sensibilidades. **Métodos**: estudo epidemiológico, descritivo com abordagem quantitativa. A amostra constou de 99 pacientes em uso de ventilação mecânica em duas unidades de terapia intensiva em um hospital público e de ensino do município de Teresina-Piauí. Os dados foram coletados por meio de um formulário nos meses de janeiro e fevereiro de 2009, processados estatisticamente e apresentados em forma de tabelas. **Resultados**: Os germes mais prevalentes foram: *klebsiella spp* (40,40%); Bacilo Gram-Negativo não fermentador (24,24%); *Staphylococcus aureus* e *pseudomonas aeruginosa* (17,17%). Evidenciou-se maior sensibilidade bacteriana ao imipenem (76,77%); meropenem (72,73%) e cefepime (58,59%). **Conclusão**: Terapêutica adequada e estratégias de prevenção reduzem as taxas de prevalência de pneumonia associada à ventilação mecânica e o surgimento de resistência microbiana. **Descritores:** Infecção hospitalar, Pneumonia, Prevalência, Testes de sensibilidade microbiana.

RESUMEN

Objetivo: Analizar la prevalencia de gérmenes relacionados con la neumonía asociada a la ventilación mecánica y los perfiles de sensibilidad. **Métodos**: enfoque cuantitativo epidemiológico, descriptivo. La muestra estuvo constituida por 99 pacientes con ventilación mecánica en dos unidades de cuidados intensivos de un hospital público y de enseñanza en la ciudad de Teresina, Piauí. Los datos fueron recolectados a través de un formulario en los meses de enero y febrero de 2009, estadísticamente procesados y presentados en tablas. **Resultados**: Los gérmenes más prevalentes fueron: *Klebsiella spp* (40,40%), Bacilo Gram-Negativo no fermentador (24,24%), *Staphylococcus aureus* y *Pseudomonas aeruginosa* (17,17%). Fue evidente una mayor sensibilidad bacteriana a imipenem (76,77%), meropenem (72,73%) y cefepima (58,59%). **Conclusión**: tratamiento adecuado y las estrategias de prevención de reducir la prevalencia de la neumonía asociada a ventilación mecánica y el surgimiento de la resistencia microbiana. **Descriptores:** Infección nosocomial, Neumonía, Prevalencia, Pruebas de sensibilidad microbiana.

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INTRODUCTION

Nosocomial Infection (NI) represents a public health problem, with a view that a portion of the population is affected by infections acquired in health institutions. This influences the increased morbidity and mortality, from direct and indirect costs, assuming the consequences of human, social and economic impact. Mechanical ventilation in association with pneumonia is considered a nosocomial infection and is considered very common in intensive care, with prevalence rates ranging from 6 to 50 cases per 100 admissions to the intensive care unit[1-2].

In Brazil, the nosocomial infection rates remain high, i.e. 15.5%, which corresponds to 1.18 episodes of infection per client admitted in hospitals, despite the existence of legislation for the appointment of the Infection Control Committee. Decree no. 2,616 /1998 conceptualizes nosocomial infection (NI) that which is acquired after the patient's admission and that manifests itself during the hospitalization or after discharge, when it can be related with the hospitalization or hospital procedures.[3-4]

The Intensive Care Units (ICUs) constitute service levels the health of high complexity, acting decisively when there is instability of organs and functional systems with risk of death. Thus, the admitted patients in ICUs are subject to risks of 5 to 10 times greater for acquiring infection other than those in hospitalization units of the hospital, because they are more exposed to risk factors such as invasive procedures, complex surgeries, immunosuppression drugs, antimicrobial agents and the interactions with the healthcare team and fomites.[3]

The professionals of the nursing team are beside the patient 24 hours of the day, therefore, active participants of therapy implemented since they provide monitoring and continuous assistance. The invasive ventilator support by means of ventilator devices, such as the endotracheal or nasotracheal (TOT) tube and the tracheotomy, tube (TQT) does not allow the patient to maintain the defense mechanisms of the airways effective, for example, filtration and humidification of the inspired air, stimulating the production of secretions. Then there is the necessity of the removal of secretions by nursing staff by means of aspiration [5.]

Among the various types of pneumonia, is most often in the ICU Ventilator-Associated Pneumonia (VAP), which is one that arises 48-72 hours after endotracheal intubation and institution of invasive MV. Similarly, VAP is also classified as early and late, being early that occurs within four days of intubation (OTI) and start the MV, and VAP late that starts after the fifth day under the same conditions.[6]

One of the methods used to identify and treat infections related to the lower respiratory tract in a hospital environment is sequential monitoring of the tracheal secretions in intubated patients in the ICU environment.[7]

The tracheal secretion cultures are used to reflect on the local colonization of microorganisms. Since the bronchoalveolar lavage (BAL) is used as a diagnostic for VAP in immune-compromised patients, and is considered the most reliable method towards microbiological investigation of the lower respiratory tract, thereby increasing the chances of success by treatment with antimicrobials.[8.]

The incorrect use of antimicrobial agents is an important factor in the pathogenesis of pneumonia, often by resistant bacteria. The strategies for prevention of Pneumonia Acquired in Hospital (PAH) and VAP may reduce the morbidity, mortality, and costs [6.]

Thus, this study aimed to analyze the prevalence of germs related Pneumonia Associated with Mechanical Ventilation in Intensive Care Units of a teaching hospital and their profiles of sensitivities.

METHODOLOGY

Descriptive, retrospective epidemiological Study with quantitative approach performed in Intensive Care Units (I and II) of a teaching hospital. For carrying out this study, we have selected a hospital of the public network, located in the municipality of Teresina - PI, by the fact that the same be a large hospital and be of reference in the whole State of Piaui and neighboring states with exclusive service by Unified Health System (SUS).

The population was composed of adult patients hospitalized in Intensive Care Units (I and II) of this hospital (N= 499). As it is a finite population and an epidemiological study, the sample (n= 99) consisted of patients hospitalized in two ICUs this teaching hospital in use of MV, from 48 hours ago, with isolated positive culture of tracheal secretions.

The inclusion criteria were patients hospitalized in ICUs (I and II) in the period 1 January to 31 December of the year of 2008 that used invasive MV and had positive culture for pneumonia from 48 hours of MV. The following patients were excluded in use of MV that had isolated negative tracheal secretion, records and results of examinations not located.

We used a form for data collection. The data were collected in the months of January and February 2009 and processed by means of the program Statistical Product and Service Solutions - SPSS 16.0, presented in the form of tables and statistically analyzed.

We used selection census in all patients hospitalized in 2008, through the database of the Commission of Infection Control (CCIH), annotations and high admissions filed in the Registry of Intensive Care Units, and records the Statistical Service Medical Records (SAME) teaching hospital.

The research was carried out in accordance with the recommendations contained in the Resolution 196/96 of the National Health Council, which brings together the ethical aspects of research involving human beings and after authorization of the Ethics and Research Committee (CEP) of the Faculty of Higher Education and Technological of Piauí - NOVAFAPI with approval number of the CAAE 0245.0.043.000 -09.

RESULTS AND DISCUSSION

The results of this study demonstrate the prevalence and the profiles of sensitivities of germs related pneumonia associated with mechanical ventilation in patients hospitalized in ICUs I and II of a public teaching hospital.

By comparing this study with other authors, it was observed that the agents that most frequently cause nosocomial pneumonia could vary greatly, according to the geographic region.

Among all the NI, pneumonia is considered worrisome for multidisciplinary health team, its severity, and these in turn raised rates in an indirect measure of the quality of care received by users in this health institution because immune-compromised patients have predisposed to this type of infection.

The pneumonias are responsible for 15% of infections related to health care and approximately 25% of all infections acquired in Intensive Care Units. The majority of these infections is associated with the MV and there are larger epidemiological indices on this type of pneumonia acquired in the hospital environment. Data from the State of Sao Paulo in 2008 showed that the median incidence of Pneumonia Associated with Mechanical Ventilation (VAP) was 16.25 cases per 1,000 days of ventilator usage in adult ICUs.[10]

The prevalence of pneumonia in two ICUs analyzed was 42.89%. The ICU II was responsible for the higher rate of respiratory infection, 54.55%,

while the ICU I had a prevalence of 45.45%, which is worrying, because it demonstrates a high index of these infections, when compared to national result (20.3%)[11]. The study found that the average time of hospitalization of patients in ICUs I and II was 27.64 days. Since the average time of use of mechanical ventilator was 20 days.

These pneumonias are directly associated with the risk factors to which they are exposed. The occurrence of pneumonia in critical patients hospitalized in orotracheal intubation and mechanical ventilator, considered risk factors.

Table 1 represents the prevalence of microorganisms isolated in ICUs I and II, these microorganisms causing pneumonia in these Units are: *Klebsiella spp*. (40,40%), Gram-Negative Bacillus (GNB) non-fermentor (24.24%), *Pseudomonas aeruginosa* (17.17%), *Staphylococcus aureus* (17.17%), *Proteus spp*. (2.02%) *and E. coli* (1.01%), being the first four those responsible for greater numbers of cases.

Table 1 Types of microorganisms per ICU (n= 99). Teresina - PI, 2008.

		IC				TOTAL	
		ICU I		ICU II			
		No.	%	No.	%	N	%
Microorganism Isolated	*Pseudomonas aeruginosa*	8	17.78	9	16.67	17	17.77
	Staphylococcus aureus	8	17.78	9	16.67	17	17.77
	E. coli			1	1.85	1	1.01
	Klebsiella spp.	18	40.00	22	40.74	40	40.40
	Proteus spp.	1	2.22	1	1.85	2	2.02
	Not BGN fermenter	10	22.22	14	25.93	24	24.24
Total		45	100.00	54	100.00	99	100.00

Source: The CCIH and SAME hospital searched.

Not sum 100% can be detected more than one microorganism.

Table 2 represents the sensitivity of microorganisms to antimicrobial agents used in ICUs I and II. It was evident in antibiograms, greater bacterial sensitivity to antimicrobial imipenem, with 76.77%, followed by meropenem, with 72.73%, with 58.59% of cefepime and amikacin, with 52.53%, and this sensitivity dependent on the isolated microorganism.

Table 2. ANTIBIOTIC Sensitivity by ICU (n = 99). Teresina (PI), 2008.

		IC				Total	
		ICU I		ICU II			
		N	%	N	%	N	%
Antibiotic Sensitivity	Amicacina	28	62.22	24	44.44	52	52.53
	Ampicilina			1	1.85	1	1.01
	Azetreonam	5	11.11	8	14.81	13	13.13
	Cefalotina	2	4.44	5	9.26	7	7.07
	Cefotaxima	12	26.27	12	22.22	24	24.24
	Ceftazimida	7	15.56	4	7.41	11	11.11
	Ceftazidima	10	22.22	12	22.22	22	22.22
	Ceftriaxona	13	28.89	13	24.07	26	26.26
	Cefepime	29	64.44	29	53.70	58	58.59
	Ciprofloxacin	23	51.11	17	31.48	40	40.40
	Clindamicina	5	11.11	5	9.26	10	10.10
	Entromácina	5	11.11	4	7.41	9	9.09
	Gentamicina	12	26.67	17	31.48	29	29.29
	Imipenem	34	75.56	42	77.78	76	76.77
	Meropenem	33	73.33	39	72.22	72	72.73
	Oxacilina	5	11.11	7	12.96	12	12.12
	Penicilina G	1	2.22	1	1.85	2	2.02
	Vancomicina	7	15.56	7	12.96	14	14.14
	Tobramácina	11	24.44	12	22.22	23	23.23
	Rifampicina	6	13.33	6	11.11	12	12.12
	Norfloxacin	9	20.00	7	12.96	16	16.16
	Outros	14	31.11	13	24.07	27	27.27
	Total	45	100.00	54	100.00	99	100.00

Source: The CCIH and SAME hospital searched.
Do not add up to 100% can be detected more than one type of sensitivity

Table 3 shows the sensitivity of the microorganisms found in the study, to the antibimicrobianos used in ICUs I and II of the public teaching hospital. It shows the predominance of the sensitivity of the microorganism *Pseudomonas aeruginosa* to amikacin (88.24%), *Staphylococcus aureus* to ciprofloxacin, oxacillin and rifampin (70.59%), BGN non-fermentor to imipenem (95.45%), and *Klebsiella pneumoniae* to imipenem (92.50%) and meropenem (90%).

In the study it was observed that the problem of nosocomial infection (NI) in this scenario presents serious proven from the high prevalence rate of pneumonia which reflects the quality of care provided to users of this health institution.

The diagnosis of nosocomial pneumonia presents many difficulties, especially in patients on mechanical ventilation. In practice, this diagnosis is based on clinical and radiological criteria, being emphasized by the presence of fever, purulent sputum, signs of pulmonary consolidation and new or progressive infiltrate to the X ray [9]

In tracheal secretion collection for microbiological examination in intubated patients, by means of aspiration probe the results of these

samples may reflect local colonization, being the extremely complicated clinical interpretation. As procedure for etiologic diagnosis of nosocomial pneumonia, this procedure is not recommend, which may lead to inappropriate therapeutic approaches.[8]

Table 3. Type of microorganism by antibiotic sensitivity(n=99). Teresina/PI, 2008.

Antibiotic Sensitivity	Isolated microorganism												Total	
	Pseudomonas aeruginosa		*S. aureus*		*E. coli*		*Klebsiella spp.*		*Proteus spp.*		*BGN Not fermentor*			
	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%
Amicacina	15	88.24	7	41,18	1	100	22	55.00	1	50.00	6	27.27	52	52.53
Ampicilina			1	5.88									1	1.01
Aztreonam	11	64.71					1	2.50			1	4.55	13	13.13
Cefalotina			7	41.18									7	7.07
Cefotaxima	1	5.88	5	29.41			13	32.50			5	22.73	24	24.24
Ceftazimida	4	23.53					5	12.50			2	9.09	11	11.11
Ceftazidima	7	41.18	1	5.88			11	27.50			3	13.64	22	22.22
Ceftriaxona	1	5.88	8	47.06			13	32.50			4	18.18	26	26.26
Cefepime	12	70.59	1	5.88			29	72.50	2	100	13	59.09	58	58.59
Ciprofloxacin	9	52.94	12	70.59			15	37.50			4	18.18	40	40.40
Clindamicina			10	58.82									10	10.10
Eritromicina			9	52.94									9	9.09
Gentamicina	7	41.18	10	58.82			7	17.50			5	22.73	29	29.29
Imipenem	14	82.35	1	5.88	1	100	37	92.50	2	100	21	95.45	76	76.77
Meropenem	14	82.35			1	100	36	90.00	2	100	19	86.36	72	72.73
Oxacilina			12	70.59									12	12.12
Penicilina G			2	11.76									2	2.02
Vancomicina			14	82.35									14	14.14
Tobramicina							14	35.00	1	50.00	8	36.36	23	23.23
Rinfampicina			12	70.59									12	12.12
Norfloxacin							13	32.50	1	50.00	3	13.64	16	16.16
Others	1	5.88	12	70.59			11	27.50			2	9.09	27	27.27
Total	17	100	17	100	1	100.0	40	100	2	100.00	22	100.00	99	100

Source: CCIH and SAME of the researched hospital

Do not sum to 100% can be detected over one microorganism.

Patients on MV are likely to suffer inoculation of microorganisms by aspiration or by aerosols. Approximately 33% of ventilator circuits are contaminated with the flora of the oropharynx of the patient after two hours of use, 64% within 12 hours and 80% at the end of 24 hours. Simple procedures such as changing positions or raise the head of the bed of the patient may cause the passage of contaminated liquid into the respiratory tract. Some authors recommend changing the ventilator circuit every 48 hours [8].

In daily practice performed by a professional emergency physician is the realization of the early intubation and invasive mechanical ventilation (IMV); however, the patient often remains in IMV mainly by the difficulty in availability of ICU beds. Increasingly the respiratory site has been implicated in source of the infectious process, which is compatible with an increase in the number of patients under mechanical ventilation and with prolonged hospitalization in ICUs. The results corroborate with the literature, since there is a high rate of infection among patients in intensive care, especially in respiratory infections whose prevalent bacteria were gram-negative: *Klebsiella pneumoniae, Pseudomonas aeruginosa and Staphylococcus aureus* methicillin resistant (MRSA). About 70% of these microorganisms have VAP in their etiology.[4,13,14]

The treatment of infections caused by BGN non-fermentor are almost uniformly susceptible to combinations as ampicillin-sulbactam, piperacillin-tazobactam or also to imipenem and meropenem. Other antimicrobials that can submit activity against these bacilli are, levofloxacin, and moxifloxacin tobramicinacom cefepime.[13]

The *Klebsiella* spp. is an Enterobacter of the gram-negative bacilli family, also it is a frequent cause of infections associated with health treatment such as pneumonia acquired in the hospital. These infections are much more difficult to deal with, because the *Klebsiella spp* strains are resistant. Some useful agents for combating this enterobacteria (except beta-lactamase-producing Extended Spectrum - ESBL) include third-generation cephalosporins such as cefotaxime, ceftriaxone, ceftizoxime, also include carbapenems like imipenem, meropenem and ertapenem (acting on these ESBL-producing strains).[13]

The *Pseudomonas aeruginosas* are also gram-negative bacilli found in the environment and it is a frequent cause of nosocomial infection, particularly pneumonia. With response to resistance strains of Pseudomonas *aeruginosa*, often are not susceptible to one or more antibiotics, such as for example recent analyzes indicate that 15 to 25% of strains are resistant to piperacillin; 20 to 30% to ceftazidime and 40 to 45%

to aztreonam. Thus, no antibiotic regimen is effective against *P. aeruginosa,* so the treatment should be directed by profiles of individual susceptibility of strains.[13]

A review of the history of attempts to treat infections caused by *S. aureus* shows the ability of the bacterium to overcome our greatest efforts in containment of antimicrobial resistance. In the 1940s and 1950s, infections caused by *S. aureus* were treated with penicillin; however, this microorganism soon developed resistance to the cited antimicrobial. Over the years new antimicrobial studies were identified as antiestafilocóccicas penicillins, cephalosporins, carbapenems and vancomycin, which were effective in solving infections caused by *S. aureus*, however, the use of these drugs did not prevent the emergence of resistant strains. The antimicrobials, such as clindamycin, ciprofloxacin, clarithromycin and azithromycin in certain infectious processes proved to be effective against *S. aureus.*[13]

The antimicrobials imipenem, meropenem and ertapenem are carbapenems currently available in clinical practice in the US, Europe and Brazil. Exhibit broad spectrum of action for use in systemic infections and are stable in the majority of ß- lactamases. Meropenem is a little more active against gram-negative bacteria, while imipenem activity presents a little higher than against gram-positive. Due to the discrete differences, with respect to the mechanism of resistance, can be found sensitive samples to a carbapenem and resistant to others. This phenomenon is relatively rare and related to resistance mechanism that involves the porinas, but has been described mainly in strains of *Pseudomonas aeruginosa.*[15]

Regarding amikacin, it has the greatest action spectrum from the aminoglycosides group and is used in infections caused by gram-negative bacilli resistant to gentamicin and empirical therapy of infections related to healthcare. Cefepime, which is a fourth-generation cephalosporin, preserves the action on gram-negative bacteria, including antipseudomonal activity, in addition to show activity against gram-positive cocci, especially oxacillin-susceptible staphylococci.[15]

The rates of VAP can vary according to the population of patients and the available diagnostic methods. The various studies show that the incidence of this infection increases with the duration of MV and point attack rates of approximately 3% per day during the first five days of ventilation and then 2% for each subsequent day. The impact of this infection is reflected in the extension of the hospitalization, at around 12 days and in the increase of costs, around 40000 dollars per episode [10.]

The advent of antibiotics and chemotherapeutics allows control and cure of various infectious diseases. However, with the emergence of bacterial resistance of some species, this has become a problem at the time of the choice of the treatment to the client. In This way, the antibiotics represent a high consumption inside the hospitals, in particular in the ICUs, where are the critical patients. The abusive use of antibiotics and the lack of criteria for the choice of empirical treatment are determining factors for the emergence of various microorganisms resistant in intensive care units [3.12.]

Oxacillin is an isoxazolilpenicilina, semi-synthetic derivative of penicillin G, is indicated for the treatment of infections caused by methicillin-susceptible staphylococci regardless of the severity of the infection. It is important to emphasize the empirical use of vancomycin for treatment of nosocomial infections, due to the increasing incidence of *oxacillin resistant Staphylococcus aureus* (ORSA). It is observed that in most hospitals the empirical treatment of staphylococcal infections usually with vancomycin or teicoplanin (with glycopeptides), however, if there is confirmation of the etiology of infection by Staphylococcus aureus sensitive to oxacillin is

rational exchange for this antibiotic in order to optimize power and minimize the impact related to toxicity, selection of resistance and costs.[16]

As shown in table 3, the best indication of oxacillin corresponds to *Staphylococcus aureus* (70.59%); however, the vancomycin still possesses a greater sensitivity, with a percentage of 82.35%. There are reports in the literature that the vancomycin is one of the antimicrobial agents that can be used for the treatment of severe infections, such as pneumonia, caused by strains of Staphylococcus *aureus resistant to oxalina*. We emphasize that in our study the *Staphylococcus aureus* was not 100% sensitivity to vancomycin due to not testing of two cases among the 17 found.[16]

It should also be observed in table 3 that the cefepime has a higher activity against *Pseudomonas aeruginosa* (70.59%). As the literature shows, this was mainly due to its greater resistance to beta-lactamase inhibitor, due to cephalosporins of "fourth generation" (cefepime), when introduced into medical practice, have a higher activity than the cephalosporins of "third generation".[16]

The use of amikacin is recommended only for the treatment of severe infections caused by sensitive bacteria in cases of sepsis, pneumonia and other serious infections of compromising the general status of the patient, most often in association with other antimicrobial agents. The percentage of strains of *Pseudomonas aeruginosa resistant* to amikacin tends to be lower than that observed in relation to gentamicin and tobramycin, because this antibiotic is sensitive to smaller number of enzymes inactivating mutations of aminoglycosides produced by Gram-negative bacilli.[16-17]

The gentamicin is the aminoglycoside endowed with greater potential synergistic with betalactam antibiotics and with vancomycin for the treatment of infections caused by streptococci and enterococci. [19] In this study the gentamicin showed a higher sensitivity to *Staphylococcus aureus* (58.82%), followed by *Pseudomonas aeruginosa* (41.18%), BGN non-fermentor (22.73%) and *Klebsiella spp (*17.50%). *E. coli* and *Proteus sp*. showed no sensitivity to gentamicin as shown in table 3.

The RIF is endowed with antibiotic activity against various microorganisms by exerting its antimicrobial activity to inhibit the RNA-dependent polymerase of deoxyribonucleic acid (DNA). Rifampicin is only available in Brazil for oral use. It is active against many bacteria, among them, *Staphylococcus aureus*[19]. According to table III, the study demonstrated that the antibiotic rifampicin showed sensitivity, among the six species prevalent, only to Staphylococcus *aureus* with a percentage of 70.59%.

The in vitro activity of imipenem is excellent for a wide variety of aerobic microorganisms and anerobicos. It is indicated for the treatment of urinary tract infections, lower respiratory tract infections, intra-abdominal and gynecological, skin, soft tissues, bones and joints.[18]

S. aureus is considered an opportunistic human pathogen and is frequently associated with nosocomial infections. In Brazil, the NI caused by methicillin-resistant S. aureus, is also high, corresponding to 40% to 80%, mainly in ICUs. [19]

Infection by *Pseudomonas spp*. is opportunistic; the existence of breaking barriers or specific defects in some of the mechanisms of immune defense and in contact with the man being necessary and may colonize different tissues. Among the most prevalent manifestations is pneumonia.[20]

Klebsiella pneumoniae is an important causative pathogen in nosocomial infections, especially in units of critical patient treatment as in ICUs. The resistance of *beta-lactamase-producing Klebsiella pneumoniae* extended-spectrum (ESBL), class of enzymes that confer resistance to all cephalosporins, cause concern in intensive care services. A rate of 20% of *Klebsiella pneumonia* are resistant to all penicillin,

cefotaximas, cefetriaxon, aztreonam, but are not resistant to carbapenicos (imipenem), since they have greater stability.[3,19]

Studies show that the importance of gram-negative bacilli non-fermentors in the hospital has increased rapidly in recent years, and its high rate of insulation may be due to the high use of antibiotics and/or failures in the implementation of control measures for hospital infection the evaluated institutions. It also confirmed that, once entered in the hospital, its eradication becomes difficult and dissemination may occur quickly and widely.[21]

Thus, the micro-organisms *S. aureus, Pseudomonas spp., Klebsiella pneumoniae* and BGN non-fermentor are part of the microbial flora of the investigated hospital ICUs, demonstrating sensitivity to antimicrobial agents and standardized some of restricted use, requiringmonitoring on the part of the CCIH of the hospital. Thus, the micro-organisms *S. aureus, Pseudomonas spp., Klebsiella pneumoniae* and BGN non-fermentor are part of the microbial flora of the investigated hospital ICUs, demonstrating sensitivity to antimicrobial agents and standardized some of restricted use, requiringmonitoring on the part of the CCIH of the hospital. The control of antimicrobial agents depends on a better quality in antibiotic therapy, and a reduction in the intensity of the spread of resistance, thus minimizing the non-rational use of antimicrobials.[16,22]

CONCLUSION

The most prevalent microorganism was *Klebsiella spp*. (40.40%), followed by BGN not fermentor (24.24%), *Staphylococcus aureus* and *Pseudomonas aeruginosa* (17.17%). The microorganisms that had lower prevalence were the *Proteus spp*. (2.02%) and *E. coli* (1.01%). It was noted that greater bacterial sensitivity to imipenem (76.77%), meropenem (72.73%) and subsequently the cefepime (58.59%).

It revealed that rates of nosocomial infection as well as multiressistência to the antimicrobial drugs are high. This is also due to the large-scale use of antimicrobials in the ICUs surveyed. The rate of respiratory infections in two ICUs was 42.89%. It was observed that the microorganisms isolated in this study and their susceptibility profiles are in accordance with the studies carried out in this area.

In ICUs, there are several predisposing factors for the development of NI as in prolonged hospitalization time, use of mechanical ventilation, invasive procedures, advanced age, among others. There is a need for continued monitoring on the part of the Commission of Hospital Infection Control (CCIH) in hospital, as recommended by the National Program of Hospital Infection Control from the Ministry of Health (MOH).

The norms for the prevention and control of nosocomial infections advocates: the practice of proper hand hygiene, the adoption of standard precaution, identification and monitoring of multi-resistant bacteria, appropriate antibiotic therapy, environmental hygiene and training of the multidisciplinary team, as important factors that may affect the results for the reduction of prevalence of NI.

Finally, the result of this study is of the utmost importance for the clarification of health professionals that deal, both directly and indirectly, with patients in Intensive Care Units. Confirming that, through proper choice of therapy used as well as prevention strategies, it potentially decreases the incidence of VAP, the emergence of microbial resistance, and reduce morbidity, mortality and hospital costs.

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